MCDONNELL DOUGLAS

Douglas Aircraft Company

THOMAS M. RYAN, JR.
Vice President
KC-10, Flight Operations,
Training, and Customer Support

July 25, 1990
C1-AF1-TMR-069

Mr. Charles W. Euler, AFS-4C1
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

Dear Mr. Euler:

Douglas Aircraft Company (DAC) has reviewed the draft of FAA/Joint Industry Noise Abatement discussion paper which was distributed during the June 19, 1990, meeting. We wish to offer the following comments:

1. We agree on the concept of three standard takeoff procedures:

   - o Normal Takeoff
   - o Standard close-in takeoff noise abatement procedures
   - o Standard far-out takeoff noise abatement procedures

   However, we do have some concerns on the specific requirements of the latter two.

2. Some MD-80 operators presently have FAA approved takeoff noise abatement procedures using manual throttle cutbacks. Since these procedures are approved, safe and presently utilized, Douglas has no problem with them. We cannot support future regulations that would infringe upon these presently approved procedures.

3. Specifically, DAC does not agree with paragraph d. (2) and (3) of page 3, where it is mandated that thrust cutbacks below 1,000 feet to gradients less than FAR 25.111 (c) (3) must have automatic cutback systems with automatic thrust advance systems and Ground Proximity Warning System (GPWS) capable of alerting the flight crew of any descent below 1,500 feet AGL.

   (a) Manual cutbacks to 1.2% single engine climb gradient have been approved to altitudes as low as 500 feet AGL without auto thrust advance systems or GPWS. These approvals should not be negated by future regulations.

(b) To our knowledge, no presently certified GPWS provides the specific requirements as written. All GPWS's permit some altitude loss following takeoff, before providing a warning. It is our opinion that a more general requirement be stipulated that would provide the intent of altitude warning, not specifically require a revision to presently approved GPWS's.

4. DAC also does not agree with paragraph 5b., page 1-2, of Attachment 1, wherein it is specified that a single flight/crew action must be initiated for thrust cutback. This wording, in its most strict interpretation, would exclude fully automatic takeoff thrust cutback systems that may be proposed in the future. Certainly today's and/or tomorrow's technologies will produce fully automatic systems that provide high levels of safety and performance. These advancements should not be curtailed by these proposed noise abatement procedures.

5. In summary, DAC supports legislation that standardizes thrust cutback procedures, and firmly believes future systems can be fully automatic and safe as well as reliable. These systems should be able to provide a thrust cutback capability for 0% engine-out climb gradient.

DAC does not support legislation that negates presently approved procedures that have been proven to be safe.

In order to assure that a unified national noise policy is established, we recommend this proposed rule making on noise abatement be developed and integrated with the efforts presently being formulated by the Aviation System Capacity Task Force Noise Working Group.

Yours very truly,

T. M. Ryan, Jr.
Vice President
KC-10, Flight Operations,
Training and Customer Support

FWH:mlb

ATCH 4 - 2

MCDONNELL DOUGLAS

Douglas Aircraft Company

9 August 1990

Mr. Charles W. Euler, AFS-4C1
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20541

FAX: (202) 267-5230

Enclosures: (a) DC-9 Super 80 FCOM, Section 4; 3 pages
(b) MD-11 GPWS Warning Envelopes, page 34-45-0; 1 page

References: (1) Telecon between You and Frank Anderson on 20 July 1990
(2) DAC Letter, from T. J. Ryan dated July 25, 1990

Dear Mr. Euler:

During the Reference (1) telecon, Frank Anderson offered to send information on presently certified Ground Proximity Warning Systems (GPWS), specifically warnings during takeoff. Frank stated that presently certified GPWS' provide flight crew warnings following some small amount of altitude loss during takeoff. But, to the best of our knowledge, no certified system provides warning for all altitude losses, however small. Paragraph 3(b) of Ref. (2) substantiated Frank's comment.

To provide additional information on this subject, enclosures (a) and (b) respectively depict the functional capabilities of the ARINC 594 MARK II GPWS installed in the MD-80/90, and the ARINC 723 MARK V GPWS installed in the MD-11.

Both the MARK II and MARK V systems provide several ARINC defined modes of operation including Mode 3, ALTITUDE LOSS AFTER TAKEOFF. Mode 3 will be the mode of interest during takeoff noise abatement thrust cutbacks.

GPWS Mode 3 provides a warning during takeoff in event of barometric altitude loss exceeding approximately 10% of the radio altitude where the initial descent began. Mode 3 is inhibited above 700 ft. AGL in the MARK II system and inhibited above 2500 ft. AGL in the MARK V system.

For further information, please contact Frank or myself.

Sincerely,

J. D. Taylor

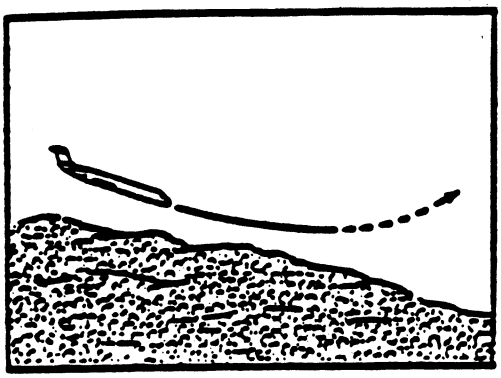
J. D. Taylor
Business Unit Manager
MD-80/90 Avionics Engineering
(213) 593-2050

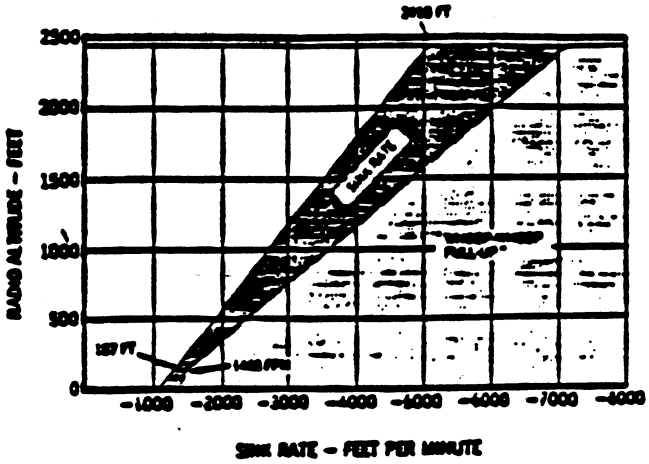
3855 Lakewood Blvd., Long Beach, CA 90846-0001 (213) 593-5511 TELEX 67-4357

ATCA 4-3

INSTRUMENTATION AND NAVIGATION - Ground Proximity Warning System Warning Annunciation

MODE 1 - EXCESSIVE DESCENT RATE



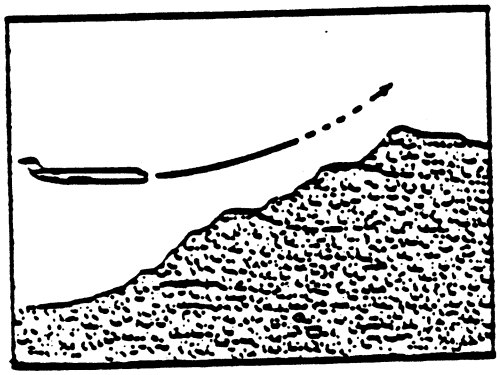


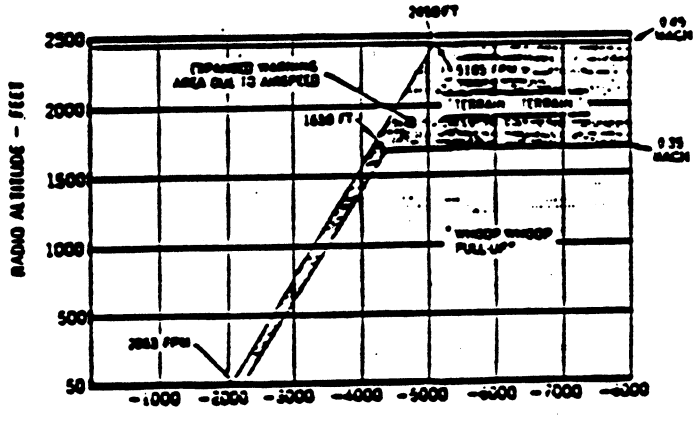
VISUAL INDICATION - GPWS light on.
AURAL/VOCAL ANNUNCIATION -
"SINK RATE, SINK RATE" (Repeated every 0.75 seconds.)
"WHOOP WHOOP-PULL UP" (Continuous)

This mode indicates rate of descent for given altitude excessive and condition should be corrected. Any excessive sink rate (barometric altitude) below 2450 feet radio altitude activates aural/vocal annunciation. Mode is independent of aircraft configuration and is functional to within 50 feet terrain.

MODE 2 - EXCESSIVE TERRAIN CLOSURE RATE

AIRCRAFT NOT IN LANDING CONFIGURATION





VISUAL INDICATION - GPWS light on.
AURAL/VOCAL ANNUNCIATION -
"TERRAIN-TERRAIN" (Rapid succession.)
"WHOOP WHOOP-PULL UP" (Repeated every 0.75 seconds)

"TERRAIN-TERRAIN" will be activated first. If rate of descent continues or increases, "WHOOP WHOOP-PULL UP" will be activated.

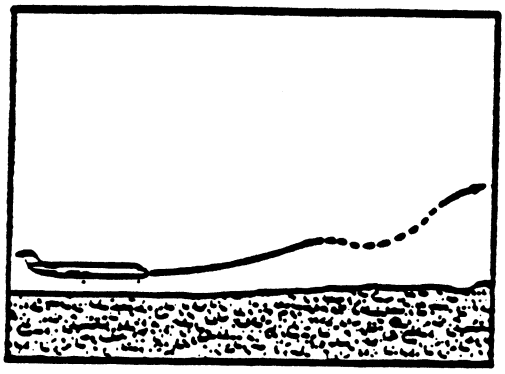
After closure continuation ceases, and "PULL UP" annunciation has stopped, a barometric altitude gain of 300 feet is required before the "TERRAIN" annunciation (repeated in 0.75 second cycle) is shutoff. During an approach, when gear or flaps are extended, the altitude gain function is inhibited and the "PULL UP" annunciation is replaced by "TERRAIN".

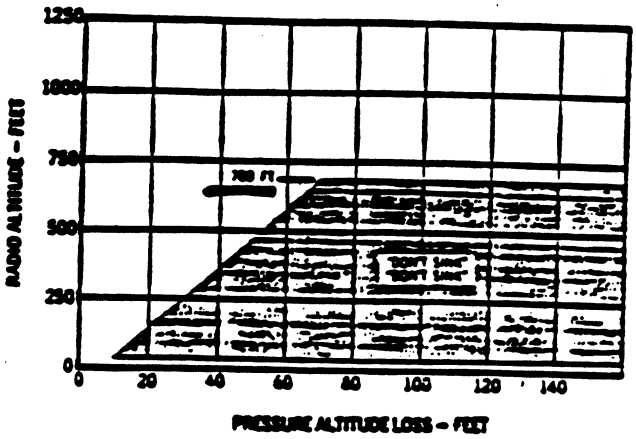
RA1-1772

INSTRUMENTATION AND NAVIGATION - Ground Proximity Warning System

Warning Annunciation

MODE 3 – Altitude Loss After Takeoff





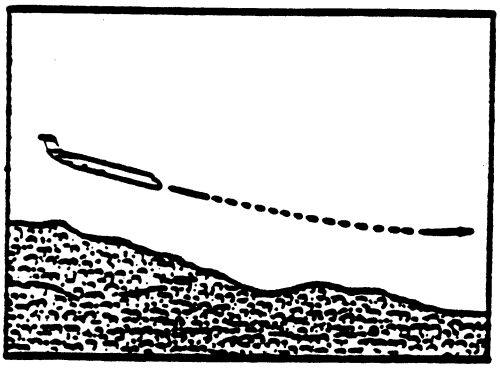
VISUAL INDICATION – GPWS light on.
AURAL/VOCAL ANNUNCIATION –

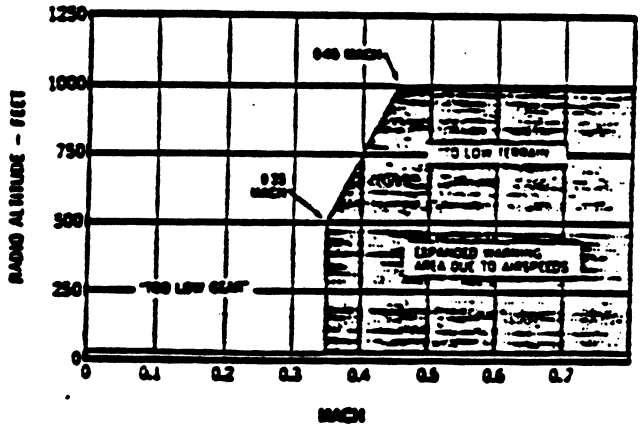
"DON'T SINK, DON'T SINK"

(Repeated in 0.75 second interval cycle until positive rate of climb is established.)

"DON'T SINK" message repeats until positive rate of climb established. At that point, the warning stops but GPWS computer continues to compare aircraft barometric altitude to the altitude of initial descent. If aircraft should descend again before climbing to initial altitude, another warning will be generated, based on original altitude. The warning threshold is when 10% (approx.) of the initial descent altitude has been lost. This mode is active from 65 feet to 700 feet AGL during takeoff or when either flaps are gear is raised during a missed approach from below 200 feet AGL. Above 700 feet, the GPWS computer automatically switches to TERRAIN CLEARANCE Mode.

MODE 4A – TERRAIN CLEARANCE (Descent in Wrong Configuration – Gear Up)





VISUAL INDICATION – GPWS light on.
AURAL/VOCAL ANNUNCIATION –

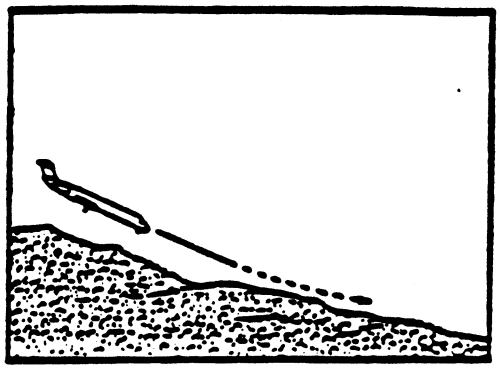
"TOO LOW GEAR" (Repeated in 0.75 second interval cycle.)
"TOO LOW TERRAIN" (Repeated in 0.75 second interval cycle.)

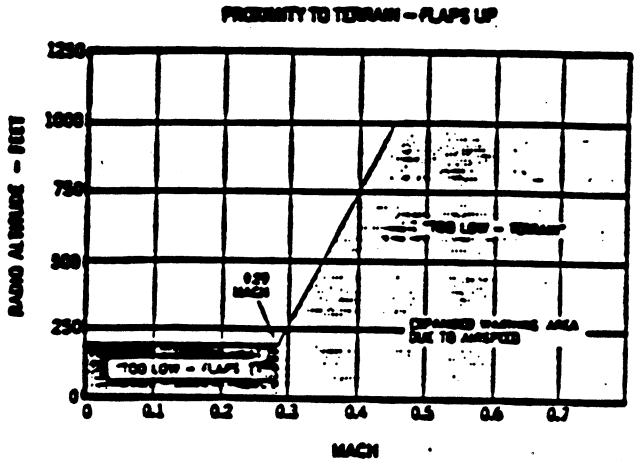
This mode is activated upon clearing 700 feet AGL after takeoff. Below 0.35 Mach, "TOO LOW GEAR" is announced. Above 0.35 Mach, "TOO LOW TERRAIN" is announced. Warning is inhibited below 50 feet.

RA1-1773

INSTRUMENTATION AND NAVIGATION - Ground Proximity Warning System Warning Annunciation

MODE 4B – TERRAIN CLEARANCE (Descent in Wrong Configuration-Gear Down, Flaps Not in Landing Position)



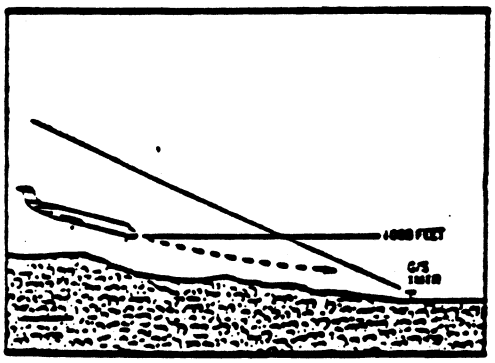


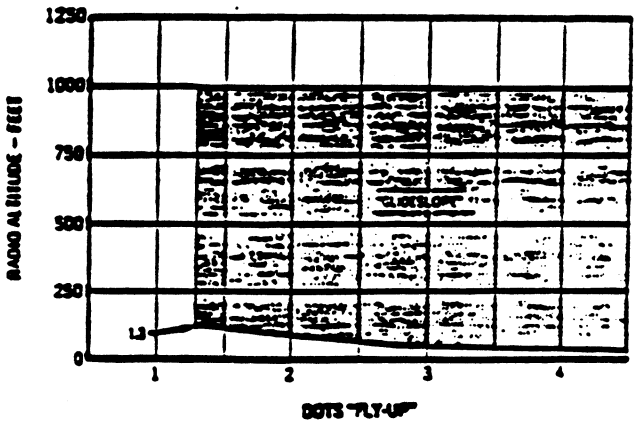
VISUAL INDICATION – GPWS light on.
AURAL/VOCAL ANNUNCIATION –
"TOO LOW FLAP" (Repeated at 0.75 second interval cycle.)
"TOO LOW TERRAIN" (Repeated at 0.75 second interval cycle.)

This Mode is activated upon clearing 700 feet AGL after takeoff. Below 0.29 Mach, with the flaps not extended for landing, "TOO LOW FLAPS" is announced.

Above 0.29 Mach, "TOO LOW TERRAIN" is announced. If gear is extended and then retracted, "TOO LOW GEAR" will be announced at 200 feet AGL if still retracted. Warning is inhibited below 50 feet and reverts to Mode 3 (with both gear and flaps down).

MODE 5 – DESCENT BELOW GLIDESLOPE





VISUAL INDICATION – BELOW G/S light on.
AURAL/VISUAL ANNUNCIATION – "GLIDESLOPE".

This mode warns of excessive low ILS glide slope deviation when the aircraft is below 1000 feet radio altitude and a valid ILS frequency is received. When the glideslope advisory region is penetrated, a soft warning is given by illumination of the BELOW G/S light and voice annunciation "GLIDESLOPE". As the altitude is decreased and the DOTS "FLY-UP" glideslope deviation is increased, the glideslope voice warning audio output level and repeat rate will increase.

ATC84-

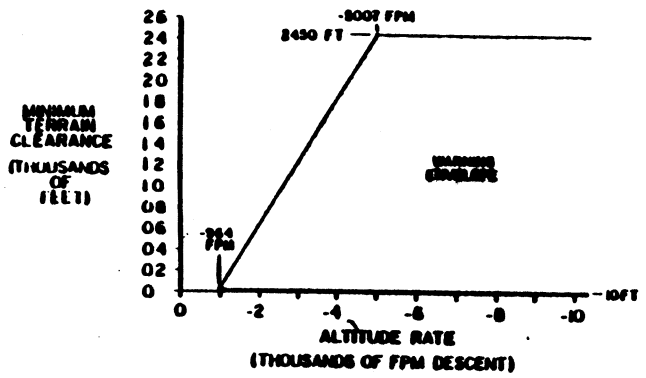
SYSTEM SCHEMATIC

PRELIMINARY

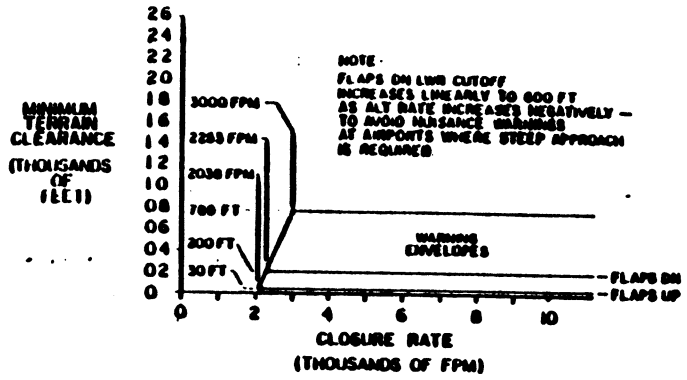
(subject to change without notice)

(McDonnell Douglas Corporation Proprietary Information) -- Use or disclosure of this information is (subject to the restriction on the title page or on the first page of this document)

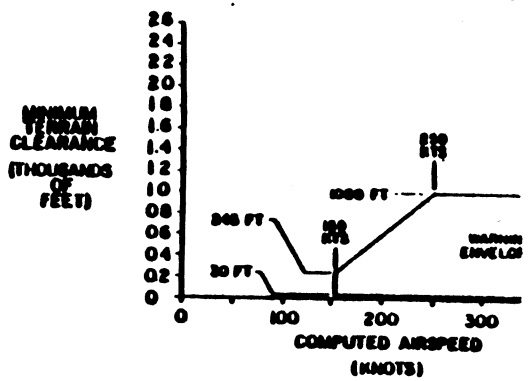
MODE 1 EXCESSIVE SINKRATE



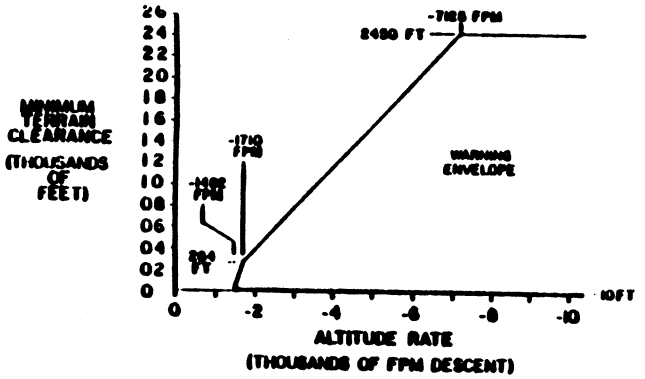
MODE 2B TERRAIN CLOSURE RATE



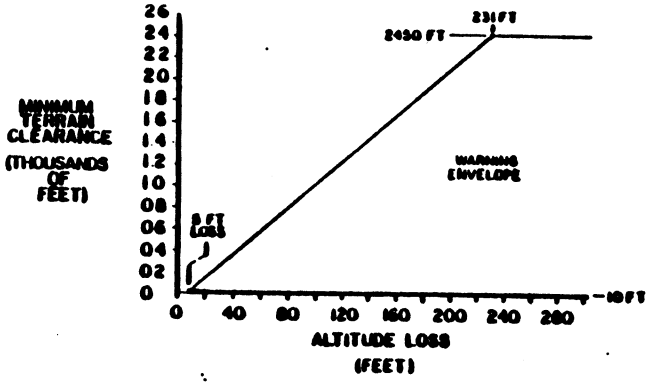
MODE 4B MINIMUM TERRAIN CLE



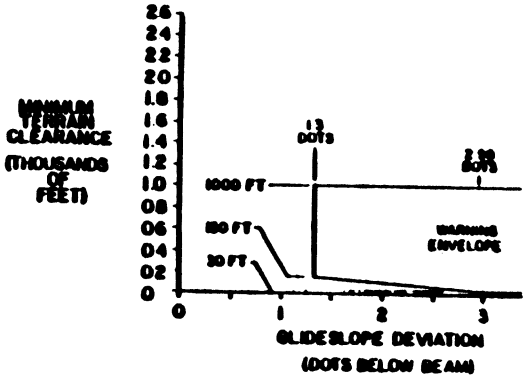
MODE 1 PULL UP



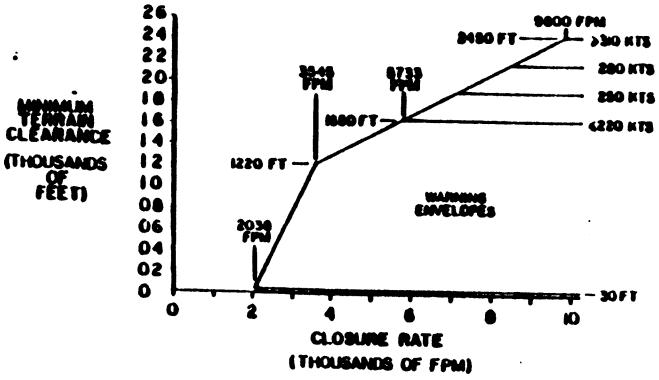
MODE 3 ALTITUDE LOSS AFTER TAKE OFF



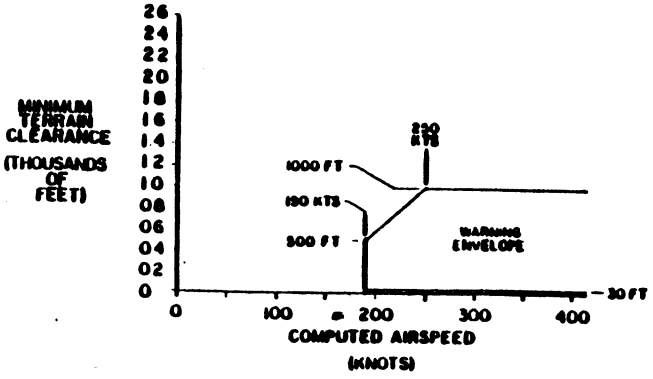
MODE 5 SOFT GLIDESLOPE



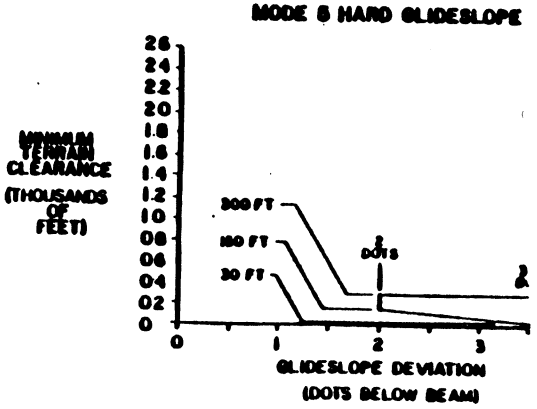
MODE 2A TERRAIN CLOSURE RATE



MODE 4A MINIMUM TERRAIN CLEARANCE



MODE 5 HARD GLIDESLOPE



ALL CUSTOMERS

APPROVAL & CHANGE RECORD			
4-12-87	Robert Scott		

34-48-0
SHEET 2 OF 2
CODE 100

TITLE: GPWS WARNING ENVELOPES

DOUGLAS | CAGE 88277 | MD-11 | 34-48 SHEET 2

MD11-34-2

Fokker comments on Joint FAA/Industry noise abatement discussion paper.

Page 1.

2b:

As the airspeed can increase above V2+20 if the airplane is limited by body angle we propose to change 2b in:

After takeoff climb at an airspeed of V2 + 10 to 20 knots or as limited by body angle whichever comes first until .....

2c and 2d:

In several FAA approved normal takeoff procedures first climb thrust is selected before flap retraction.
In Europe the IATA procedure is often used (climb thrust at 1500 ft and flap retraction at 3000 ft). We propose to leave open the sequence of climb thrust selection and selection of flaps.

Attachment 1-1:

3 Reduced thrust takeoffs.

We think it is not useful to carry out a reduce thrust takeoff in combination with a noise abatement procedure but why should it be prohibited?

4c. Definition of alert eye position should be given.
5° forward of reference eye position?

Attachment 1-2

4e How many times should the mean deviation be determined in order to find a reliable statistical value? Is 5 seconds the right time limit?

5d3 and 5e3:

It must be shown to be improbable that the automatic thrust advance feature has unacceptable failure modes.
This cannot be determined by an operational test or an evaluation. It should be done by failure analysis.
We propose a separate paragraph with airworthiness requirements as: performance, handling qualities, failure analyses etc. for certification and a paragraph dealing with operational tests and evaluations for approval of the procedure. In that case it is also clear for the manufacturer and/or operator whether FAA Flight Standards or FAA Airwirthiness has to be approached.

Attachment 1-3. 6a and 6b.
Attachment 1-4. 7b4.

In above mentioned sections the speedloss is restricted to (V2+x)-5 and to (V2+x)-2 not to exceed 10 seconds. It is Fokkers opinion that for take off the real minimum takeoff speed is V2 (Indicated on EFIS by amber band).

ATCB4-8

After and during thrust reduction a small speed drop is acceptable especially if the speed trend is small. A relevant requirement is that any speedloss must not exceed (V2+x)-5. A requirement for a speed loss of (V2+x)-2 not to exceed 10 seconds is superfluous.

In case of an engine failure the only requirement should be that speed loss must not exceed V2.
Minimum speed after an engine failure is V2.

Attachment 1-3. 6d.

Fokker does not agree that the pilot flying should be able to perform the thrust cutback procedure without assistance of the other pilot.
A noise abatement procedure must be developed for minimum workload by crew coordination.

Attachment 1-4.

Note: This note gives the impression that it is allowed to engage the autopilot below 500 ft. Hopefully this will be approved.
If the autopilot meets all the requirements to be engaged after lift off, it should be recommended to do so after lift off.

Standard alternatives, speed requirements.

If the airplane has a low weight and is body angle limited, the speed can increase above V2+20. This is of course safe. Therefore there should be no limitation on speeds above V2+20.

General remarks.

It was noticed that both thrust and power is used in the paper. We use thrust for turbojet airplanes and power for propeller airplanes.
We propose to use only thrust.

Several times takeoff path engine inoperative climb is used in the paper.
Should it not be takeoff path one engine inoperative climb.

ATC44-

P.O. Box 3707
Seattle, WA 98124-2207

July 16, 1990
B-V20B-1048

BOEING

Wes Euler, FAA
AFS 400
800 Independence Avenue S.W.
Washington, D.C. 20591

Dear Wes,

Enclosed is the Boeing response to your "Joint FAA/Industry Noise Abatement Paper." The format of this response modifies the wording of the paper and marks areas of change by a bar notation in the right margins. Explanations are provided in italicized letters where it was deemed necessary to convey our reasons for the change. Other changes were assumed self-explanatory.

An additional option exists rather than making an extensive change to AC91-53 and is described here in concept with the details to be worked out. The additional option contains two primary elements: 1) Cutbacks below 1000 feet AGL and/or below FAR 25.111(c)(3) engine inoperative gradients would not be allowed, and 2) airport noise rules based on noise monitors closer than the distance necessary for airplanes to become stabilized at cutback power after reaching 1000 feet AGL would not be allowed. This additional option would have the benefits of enhanced safety, quieter environment for the majority of the communities and greater standardization of takeoff procedures. It should be emphasized that element number 2 (above is an essential ingredient to the viability of this option.

Please call me at telephone number 206-655-3041 or Dick Potter, 206-234-5729, if you would like to discuss these matters.

Sincerely,

M E Hewett

M. E. Hewett
Engineering Test Pilot

ATC84-10

JOINT FAA/INDUSTRY NOISE ABATEMENT PAPER

JUNE 19, 1990

Proposed Resolution: The following proposal is offered for the purpose of initiating discussion and to serve as a basis for exploring alternative approaches and should not be construed as an FAA recommendation or position.

1. Develop and publish a revision to Advisory Circular (AC) 91-53 to establish a set of standard noise abatement procedures from which an operator can select one or two of the procedures as the standard for a particular airplane type. The (AC) would specify that an operator could select a procedure or a combination of procedures which is or are optimal for that airplane type. The operator would then train flightcrews who operate that airplane type to use only the selected procedure or combination of procedures. Once the standard procedure or procedures were adopted by an operator, they would be used, as appropriate, for all airport/community environments. For the purpose of standardization, efficiency of training, noise abatement and airport/community planning up to three standard takeoff procedures for each airplane type could be used. The three standard takeoff procedures for the purpose of this discussion are referred to as follows:

- Normal takeoff procedure
- Standard close-in takeoff noise abatement procedure
- Standard far-out takeoff noise abatement procedure

2. Normal Takeoff Procedure: The normal takeoff procedure may be developed by the manufacturer and adopted by the operator or it may be a procedure developed by the operator. The normal takeoff procedure would be used on runways where noise abatement is not a factor or on runways where the standard noise abatement procedures do not provide any significant or the desired noise relief. The normal takeoff procedure would be reviewed and approved at the local FAA District Office level provided it is consistent with the criteria listed below:

a) Set takeoff thrust as specified by the operator (either maximum takeoff thrust or an appropriate reduced takeoff thrust setting).

b) After takeoff, climb at an airspeed $V_2 + X$ knots until attaining an altitude specified by the operator (either a standard altitude or an obstacle clearance altitude) but not lower than 400 feet.

c) At the altitude specified by the operator, decrease pitch and accelerate to V_2f while retracting flaps on schedule (if flaps are not used for takeoff, decrease pitch and accelerate to climb speed).

d) After attain V_2f or at a point specified by the operator, set climb thrust and initiate a climb profile as specified by the operator.

ATCH 4-11

3. Standard Noise Abatement Procedures: Perceived takeoff noise depends on the airplane/engine combination, takeoff configuration, performance characteristics, and the takeoff initial climb procedure used as well as the environmental (noise sensitive) characteristics of the airport. An operator may determine that for a particular airplane type the normal takeoff procedure provides the best overall relief at noise sensitive airports (including both close-in and far-out noise sensitive areas). For another airplane type, an operator may determine that a single noise abatement procedure is appropriate for both close-in and far-out noise sensitive areas and as a result the operator would adopt and use both a normal takeoff procedure and a single standard takeoff noise abatement procedure. However, for many airplanes in operation today, there is an optimal takeoff procedure which provides the most relief for close-in noise sensitive areas and another takeoff procedure which provides the most relief for noise sensitive areas that are further out from the runway. As a result, an operator may determine that three takeoff procedures need to be adopted for the type of airplane operated and the environmental characteristics of the airports served. An operator would not be authorized to use more than three standard takeoff procedures (a normal, close-in, and a far-out takeoff procedure).

a. Noise abatement procedures are either developed by the manufacturer and adopted by the operator or they are developed by the operator. There are two general categories of noise abatement procedures.

1) One category provides relief to noise sensitive areas that are "close-in" to the end of the takeoff runway. The procedures in this category generally involve climbing in the takeoff configuration to a specified altitude and then simultaneously decreasing pitch and setting a predetermined cutback thrust and either overflying the noise sensitive area before accelerating, retracting flaps, and setting climb power, or accelerating and retracting flaps while overflying the noise sensitive area, before setting climb power.

2) The other category provides relief to noise sensitive areas that are "far-out" from the end of the takeoff runway. The procedures in this category generally involve climbing in the takeoff configuration to a specified altitude and then decreasing pitch to accelerate while retracting flaps and after the flaps are retracted (or partially retracted) setting a predetermined cutback thrust and overflying the noise sensitive area before setting climb power.

b. The optimum type of procedure for either a close-in or far-out noise sensitive area is highly dependent on the airplane's takeoff configuration and performance characteristics as well as the takeoff weight. If it is determined that both close-in and far-out noise abatement procedures are needed for a particular airplane type, an operator would be able to select two standard noise abatement procedures and train flightcrews in their use. The operator, in this case, would have to instruct flightcrews on which procedure to use for particular runway/noise sensitive area environment.

ATCH 4-

c. Obstacle clearance requirements must be considered when selecting an altitude at which either a flap configuration change is initiated or at which a thrust cutback is initiated for noise abatement purposes. Obstacle clearance altitudes are a variable altitude depending on the airport and surrounding terrain or obstacles. The amount of noise relief provided by a standard noise abatement procedure at a particular runway/noise sensitive area environment is also dependent on the altitude at which either the flap configuration change is initiated (with subsequent thrust cutback) or at which the thrust cutback is initiated in the takeoff configuration. By adjusting this initiating altitude, noise relief can be optimized for a particular runway/noise sensitive area environment. The initiating altitude would be the only variable permitted for particular standard noise abatement procedure. The operator would have to specify the initiating altitude for a particular runway/noise sensitive area environment.

d. When the initiating altitude is established at the lower altitudes, the available airspace in which to maneuver is decreased. In addition, decreased thrust levels, decreases performance margins. Therefore, in order to ensure adequate safety, specific criteria would have to be met before approving the use of an initiating altitude below 1,000 feet and/or approving the use of a cutback thrust setting lower than that necessary to maintain the takeoff path engine-inoperative climb gradients specified by FAR 25.111(c)(3) (assuming an engine failure without any thrust advance on the remaining engine(s)). The general criteria that would have to be met for each procedure and airplane type are as follows:

(1) The procedure would have to operationally evaluated and tested by the FAA for the airplane type. The factors and specific criteria that would be considered by the FAA are outlined in Attachment 1. The Director, Flight Standards Service (AFS-1) would be responsible for reviewing the results of the tests and if satisfactory approving the procedure for the particular airplane type. Once a specific procedure for an airplane type has been approved by AFS-1, it could then be approved for specific operators.

(2) Any procedure which specifies a cutback thrust of less then that necessary to maintain FAR 25.111C(3) gradients would have to incorporate an automatic thrust recovery system. In no case shall the thrust be cut back to less than 0% all engines. I

Explanation:

The requirement for a thrust recovery system should be a function only of the magnitude of the thrust cutback.

FAR 25.111c(3) specifies an engine out gradient starting at 400 ft. that provides an obstacle clearance path. (See Fig. (1)). Any close-in noise abatement takeoff with a cutback initiated above 400 ft. and the appropriate thrust restoration method can

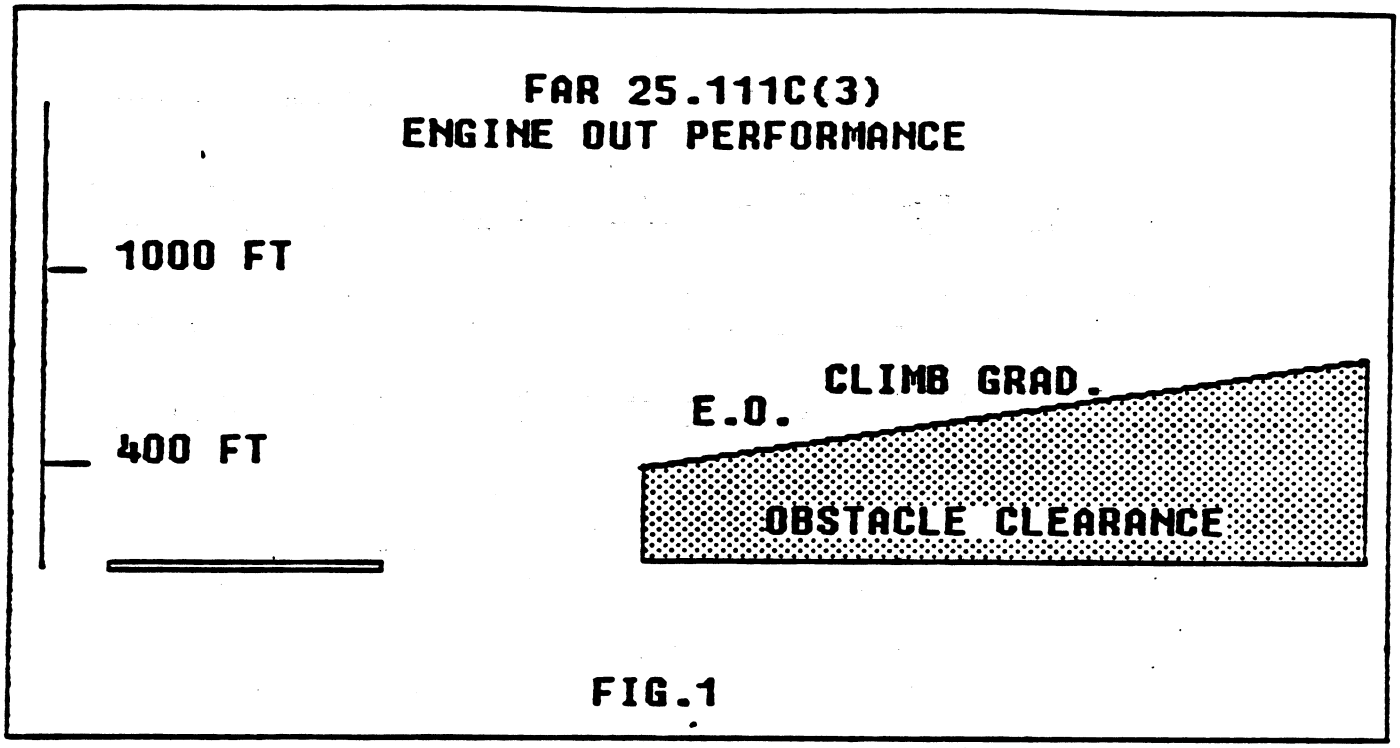

FAR 25.111C(3)
ENGINE OUT PERFORMANCE
1000 FT
400 FT
CLIMB GRAD.
E.O.
OBSTACLE CLEARANCE

FIG.1

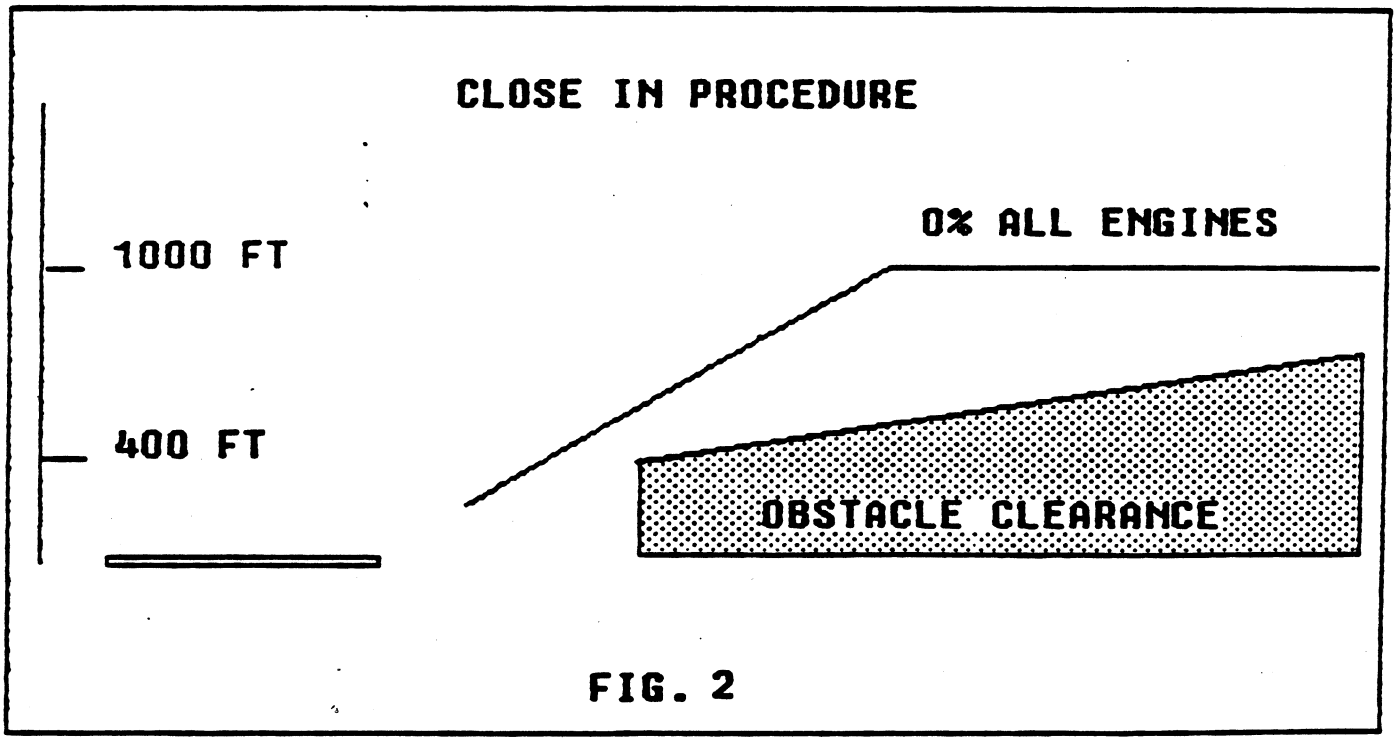

CLOSE IN PROCEDURE
1000 FT
400 FT
0% ALL ENGINES
OBSTACLE CLEARANCE

FIG. 2

maintain the aircraft at or above the FAR 25.111C(3) obstacle clearance path. (See Fig. (2)).

(3) Any procedure which specifies any cutback less than 1000 ft. AGL would have to incorporate an automatic thrust cutback feature. I

Explanation:

The requirement for an automatic thrust reduction system should only be a function of the cutback altitude. The cutback system is designed to reduce both pilots workload while in close proximity to the ground. An altitude of 1000 ft. is a typically accepted safe altitude for pilot manual actions such as manually setting climb thrust and moving flap levers.

(4) All procedures which specify a cutback altitude below 1500 ft. AGL shall require a GPWS alerting system. I

Explanation:

A requirement to provide crew alerting for unacceptable altitude losses during the noise abatement maneuver stands alone. Altitude loss can occur for reasons not associated with the magnitude of the thrust cutback ie. pilot distraction, disorientation, etc.

e. In the interest of keeping the standard noise abatement procedures to a minimum, operators would be able to request that the procedures outlined in Attachment 2 (close-in) and Attachment 3 (far-out) be approved for their operations. The procedures presented in Attachment 2 and 3 are examples only and are offered for the purpose of generating discussion and more in-depth examinations. The approval level would be indicated for each procedure. An operator may request approval of a procedure different than the ones outline in Attachments 2 and 3 by submitting a request through the assigned POI to AFS-1 for appropriate processing.

ATCAA-15